Studies on Some Haematological Parameters among Malaria Infected Patients Attending a Tertiary Hospital in Nigeria

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Abstract
Malaria is among the leading public health issues in Subsahara Africa. Among malaria patients there are changes in the haematological status. The study investigated haematological status of malaria parasite infected patients attending outpatient clinic at Federal Medical Centre Yenagoa, Bayelsa state, Nigeria. 43 participants comprising of 21 males and 22 females within the age of 18-45 years were involved in the study. Another 20 age matched individuals with no case of parasitaemia served as control. Blood samples were collected by venipuncture techniques. The samples were analyzed using Westergren method for erythrocyte sedimentation rate (ESR) and automated haematology analyzer for full blood counts (System XS-1000i). Results showed that the test and control participants (males) were 10.46g/dl and 13.64g/dl respectively (haemoglobin), 33.86% and 41.05% respectively (packed cell volume), 8.45×10⁹/L and 7.32×10⁹/L respectively (total white blood cell count), 185.29×10⁹/L and 259.45×10⁹/L respectively (platelets) and 30.33mm/hour and 8.45mm/hour (erythrocyte sedimentation rate) and for females; 10.10g/dl and 13.36g/dl respectively (haemoglobin), 30.91% and 40.05% respectively (packed cell volume), 9.13×10⁹/L and 7.27×10⁹/L respectively (white blood cell), 176.36×10⁹/L and 252.50×10⁹/L respectively (platelets) and 34.00mm/hour and 7.85mm/hour (erythrocyte sedimentation rate) (females). There was a significant (P<0.05) reduction in platelets, packed cell volume, haemoglobin, and elevation in white blood cell and erythrocyte sedimentation rate. The alterations may suggest risk of anaemia and thrombocytopenia in the patients. Therefore, there is the need for immediate diagnosis at early stage of the infection for proper treatment.

Keywords: Blood; Haematological aberration; Mosquito; Parasitaemia; Public health

Introduction
Malaria is among the major public health concern in Sub-Saharan Africa [1-3]. As such it’s one of the major causes of mortality and morbidity especially in children [4]. Majority of malaria infection occurs in Sub-Saharan Africa as against any other area in the world. Malaria endemicity vary from country to country [4], and Approximately 15 nations accounts for 80% and 78% of cases and deaths emanating from malaria infection on global scale, respectively [5]. Malaria is endemic in Nigeria, Democratic Republic of Congo (DRC), Ethiopia, and Uganda and as such approximately half of global malaria case occurs in these regions [6].

Malaria is caused by plasmodium species (a protozoan). Four major species of plasmodium exist in Africa including ovale, vivax, falciparum, malariae [3,7-9]. Among the species, P. falciparum is the major cause of malaria in West Africa [10].

Malaria is transmitted by Mosquito, an iniquitous dipteran fly. Mosquito has the tendency to transmit malaria and host of other diseases [11] including filariasis, yellow fever, dengue fever, encephalitis, chikungunya, yellow and dengue fevers, lymphatic filariasis especially in tropical countries. Different species of mosquito belong to varying genera (viz: Aedes, Culex, Anopheles and Mansonia etc) exist and they can transmit different diseases in both humans and animals.

Specifically the genus Anopheles is a major vector that transmits malaria parasite. Several species of the genus exist, but the common species include Anopheles gambiae, A. funestus, A. arabiensis and A. melas [12]. But in Nigeria, Anopheles gambiae is among the frequently encountered species. The parasite is transmitted through bite of an infected female anopheles mosquito [4]. Anopheles mosquito that carries the parasite
Participants of this research were pregnant women, lactating mothers, and individuals with known cases of HIV/AIDS, hepatitis, B and C, tuberculosis, diabetics and cardiovascular diseases were excluded from this study.

Blood collection

A standard venipuncture approach was used to collect 5ml of blood from each subject from the anticubital or dorsal vein and dispensed into a dipotassium EDTA anticoagulant vacutainer containing 1.5mg/ml of anhydrous salt and mixed for haemoglobin concentration, packed cell volume, platelets count, total while blood cell count, differential counts and erythrocyte sedimentation rate.

Statistical analysis

The resultant values were subjected to descriptive statistics and presented as mean ± standard deviation, and between the test and control subjects, t-test was used to show significant difference at P<0.05 using SPSS version 20 software.

Results and Discussion

The haematological status of malaria infected patients attending Federal Medical centre Yenagoa is presented in Table 1 and 2 for males and females, respectively. In the males malaria infected and control subjects the values were 10.46g/dl and 13.64g/dl respectively (haemoglobin), 33.86% and 41.05% (erythrocyte sedimentation rate). Furthermore in females, respectively (platelets) and 30.33mm/hour and 8.45mm/hour (erythrocyte sedimentation rate).

Selection criteria for subjects

Inclusion criteria: Participants of this research were individuals attending the general outpatient department of the Federal Medical Centre Yenagoa, Bayelsa state within the age of 18-45 years. Generally, 43 individuals comprising of 21 males and 22 females. Only subjects who's blood samples were confirmed positive for the presence of malaria antigen using rapid diagnostic test kit supplied by ACCESS BIO were recruited for the study. Also another 20 age matched subjects were used as control. The control subjects were confirmed negative using the same procedure.

Exclusion criteria: Pregnant women, lactating mothers, and individuals with known cases of HIV/AIDS, hepatitis, B and C, tuberculosis, diabetics and cardiovascular diseases were excluded from this study.

Laboratory analysis

Full blood counts including white blood cells count, haemoglobin concentration, platelets count and differential count were estimated using sysmex XS1000i automated haematology analyzer. Erythrocyte sedimentation rate was estimated using westergren method Alexy et al. [24] with slight modification by Eledo [25], Eledo et al. [23].

Materials and Methods

Study area

Yenagoa is among the developing cities in Nigeria. Yenagoa is the capital of Bayelsa. The state lies in the sedimentary basin, and fishing is a major occupation of the indigenous people of the area. Civil service and business are also source of livelihood of resident of the area. The atmospheric temperature (28 ± 6 °C) and relative humidity (50-95%) is also common to other region in Niger Delta region of Nigeria [19-23].
The significant elevation in white blood cell counts and decline in packed cell volume and haemoglobin in malaria infected patients suggests effect of infection and stress. Obeagu et al. [15] reported that elevation in platelets and white blood cells counts and decline in red blood cells, haemoglobin, packed cell volume etc is an indication of the release of leukocytes as a result of infection and stress. Furthermore, an elevated erythrocyte sedimentation rate is one of the main characteristics in individuals infected with malaria, and increased sedimentation of the red cells regularly manifest in elevated serum globulin [1]. According to Francis et al. [1], lower concentration of packed cell volume could be associated to mechanical devastation of parasitized red cells. Furthermore, the authors also reported that lower neutrophils could enhance development of neutropenic leukocytopenia due to an increase in mononuclear, while lower platelets could be due to hyper-reactive splenomegaly in addition to humoral immune-response. The findings of this study had dissimilarity with the work of Okoroiwu et al. [4] that reported significant decline in basophils, eosinophils, monocytes, lymphocytes, neutrophils and white blood cells, but showed similar trend in the case of packed cell volume and platelets. The trend also showed some similarity with the work of Francis et al. [1] that reported significant decrease in pack cell volume, platelets, neutrophils, eosinophils, and significant elevation in white blood cells, erythrocytes and sedimentation rate, basophils, eosinophils, monocytes and lymphocytes. The observation in this study is comparable to the trend of packed cell volume, white blood cell and platelets reported by Garba et al. [18].

The variation could be due to age of the patients, and other underlined medical conditions that is not known at the time of the study. According to Francis et al. [1], red cells parasitization and destruction are usually low in regions of stable malaria and 40.05% respectively (packed cell volume), 9.13×10^9/L and 7.27×10^9/L respectively (white blood cell), 176.36×10^9/L and 252.50×10^9/L respectively (platelets) and 34.00 mm/hour and 7.85 mm/hour (erythrocyte sedimentation rate). There was significant variation (P<0.001) among the subjects and the control.

### Table 1: Effect of malaria on some haematological parameters in males among patients attending out-patient unit of Federal Medical Centre Yenagoa, Bayelsa state Nigeria.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean ± Standard Error</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subjects (n=21)</td>
<td>Control (n=20)</td>
<td></td>
</tr>
<tr>
<td>PCV, %</td>
<td>33.86 ± 0.47</td>
<td>41.05 ± 0.40</td>
<td>-11.528</td>
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<tr>
<td>Hb, (g/dL)</td>
<td>10.46 ± 0.22</td>
<td>13.64 ± 0.13</td>
<td>-12.257</td>
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<tr>
<td>WBC, ×10^9/L</td>
<td>8.45 ± 0.19</td>
<td>7.32 ± 0.23</td>
<td>3.830</td>
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<tr>
<td>Platelets ×10^9/L</td>
<td>185.29 ± 5.65</td>
<td>259.45 ± 10.56</td>
<td>-6.275</td>
</tr>
<tr>
<td>ESR, mm/hour</td>
<td>30.33 ± 1.46</td>
<td>8.45 ± 0.60</td>
<td>13.592</td>
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<tr>
<td>Neutrophil, %</td>
<td>71.05 ± 0.89</td>
<td>65.15 ± 0.89</td>
<td>4.676</td>
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<tr>
<td>Lymphocytes, %</td>
<td>24.38 ± 0.73</td>
<td>29.15 ± 0.87</td>
<td>-4.223</td>
</tr>
<tr>
<td>Monocytes, %</td>
<td>1.62 ± 0.15</td>
<td>3.60 ± 0.47</td>
<td>-4.089</td>
</tr>
<tr>
<td>Eosinophils, %</td>
<td>2.62 ± 0.23</td>
<td>1.80 ± 0.21</td>
<td>2.584</td>
</tr>
<tr>
<td>Basophile, %</td>
<td>0.29 ± 0.10</td>
<td>0.30 ± 0.13</td>
<td>-0.088</td>
</tr>
</tbody>
</table>

### Table 2: Effect of malaria on some haematological parameters in females among patients attending out-patient unit of Federal Medical Centre Yenagoa, Bayelsa state Nigeria.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean ± Standard Error</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subjects (n=22)</td>
<td>Control (n=20)</td>
<td></td>
</tr>
<tr>
<td>PCV, %</td>
<td>30.91 ± 0.64</td>
<td>40.05 ± 0.56</td>
<td>-10.649</td>
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<tr>
<td>Hb, (g/dL)</td>
<td>10.10 ± 0.19</td>
<td>13.36 ± 0.18</td>
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<tr>
<td>WBC, ×10^9/L</td>
<td>9.13 ± 0.16</td>
<td>7.29 ± 0.25</td>
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<tr>
<td>Platelets ×10^9/L</td>
<td>176.36 ± 4.00</td>
<td>252.50 ± 10.44</td>
<td>-7.298</td>
</tr>
<tr>
<td>ESR, mm/hour</td>
<td>34.00 ± 1.40</td>
<td>7.85 ± 0.64</td>
<td>16.407</td>
</tr>
<tr>
<td>Neutrophil, %</td>
<td>73.09 ± 0.66</td>
<td>65.05 ± 0.79</td>
<td>7.840</td>
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<tr>
<td>Lymphocytes, %</td>
<td>23.14 ± 0.63</td>
<td>29.20 ± 0.77</td>
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<tr>
<td>Monocytes, %</td>
<td>1.14 ± 0.07</td>
<td>3.70 ± 0.42</td>
<td>-6.327</td>
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<tr>
<td>Eosinophils, %</td>
<td>2.14 ± 0.21</td>
<td>1.80 ± 0.22</td>
<td>1.120</td>
</tr>
<tr>
<td>Basophile, %</td>
<td>0.23 ± 0.09</td>
<td>0.25 ± 0.12</td>
<td>-0.150</td>
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</tbody>
</table>
among adolescence and adult. According to Subhashree et al. [26], haematological status is influenced by factors including age, ethnicity, diet, genetic and gender.

The major blood characteristics showed that packed cell volume, and platelets were lower in females compared to male, while white blood cell and erythrocytes sedimentation rate were higher in female compared to male. This trend has been reported by Francis et al. [1].

**Conclusion**

This study found that plasmodium parasitaemia leads to variation in haematological status. Thus, causing a significant reduction in neutrophil, lymphocytes, monocytes, haemoglobin and packed cell volume, and increase in erythrocyte sedimentation rate and white blood cell counts among patients when compared with the control subjects. These variations suggest the possible risk of anaemia in patients. Hence there is the need for immediate diagnosis when the symptoms are observed to enhance effective management.

**Authors’ Contribution**

Author BOE conceived the idea, involved in sample collection and laboratory analysis. Author SCI managed literature search, carried out the statistical analysis and wrote the initial draft. All authors approved the manuscript.

**Ethical Consideration**

Permission was obtained from the ethics committees of the Medical Laboratory Science Department of Madonna University, Elele, Nigeria and Federal Medical Centre Yenagoa, Nigeria. Informed consent was obtained from the patients prior to sample collections.

**References**


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